the present time is to be realized, it is necessary for a system designer to separately prepare programs that causes desired processes at desired time points. Therefore, it is difficult to realize a general scheme that enables change of processes dependent on time.

In other words, in a model having time constraint on procedure contents and method of display, and information processing is performed based thereon, a specific resolution to realize coordination among objects is needed.

Disclosure of the Invention

An object of the present invention is to provide apparatus and method of information processing, an information processing program and medium that enable adaptive information processing of objects of which elements or procedures can be described at least based on time-related information, by changing the property thereof including display and meaning through processing based on the time information.

Another object of the present invention is to provide apparatus and method of information processing, an information processing program and medium that can realize a user interface capable of providing appropriate information to the user, by changing behavior including processing and meaning, through processing based on the time information.

According to an aspect, the present invention provides an information processing apparatus, including: determining means for performing, on an object of which element or procedure can be described based at least on information related to time, a process based on time information for determining an element or procedure of the object; executing means for executing a process based on contents of the process determined by the determining means; and object management means storing the object for managing its operation and status.

Preferably, the apparatus further includes event notification means registering and holding an event condition based on external information, for notifying the object management means about an event that occurs when the condition is satisfied; wherein

the event notification means and the object management means each include interface means for performing an event input/output operation; and the executing means changes the process in an event-driven manner in response to the event input/output operation.

Preferably, the determining means has object generating means for newly generating, after determination of contents of the element or procedure of the object, an object based on the result of determination; and the executing means performs a process based on the generated object.

Preferably, in the object to be processed by the information processing apparatus, a plurality of contents of elements and procedures of the object are prepared, the plurality of contents of elements and procedures are fully contained in a single object, and the contents are selectively determined by processing the time information.

Preferably, in the object to be processed by the information processing apparatus, contents of an element or procedure of the object can be described in a form of external reference; and in determining contents of an element or procedure of an object, when any item requires external reference for resolution, the determining means requests the object management means for the resolution and determines the contents of processing.

Preferably, the object management means has storing means, searching means for searching for an object stored in a storage area of the storing means, and communication means for obtaining information through a network, and in response to a request from the determining means, searches and obtains necessary information under control or through the network, and notifies the determining means about the contents, whereby the item requiring external reference is resolved and the contents of processing are determined.

Preferably, the object to be processed by the information processing apparatus has such a format of representation that a specific value or method related to its element or procedure is determined for the first time when the determining means applies the time information.

Preferably, when the determining means applies time of activation, the object to

be processed by the information processing apparatus has a data value or method related to its element or procedure determined.

Preferably, when the determining means applies virtual time of activation, the object to be processed by the information processing apparatus has a data value or method related to its element or procedure, based on the condition, adapted and determined.

Preferably, the object to be processed by the information processing apparatus has contents of its element or procedure described in a form of a time-related function, and when the determining means applies the time information, a data value or method related to its element or procedure is determined.

Preferably, in the object to be processed by the information processing apparatus, different time-constrained condition may be imposed on every uniquely identifiable element or procedure defined in the object, and the determining means selects an appropriate process at a timing of applying the time information.

Preferably, in the object to be processed by the information processing apparatus, description simultaneously including descriptions based on a plurality of time constraints may be made as long as there is no time crossing, on every uniquely identifiable element or procedure defined in the object; and the determining means selects an appropriate process at a timing of applying the time information.

Preferably, time constraint related to an element or procedure defined in the object to be processed by the information processing apparatus is described as a condition of invalidating the corresponding element or procedure.

Preferably, in determining contents of an element or procedure related to the object to be processed, when there are no items that satisfy a time-constrained condition, the determining means makes a notification to the object management means and any process related to the object thereafter is stopped.

Preferably, in determining contents of an element or procedure related to the object to be processed, when there is no item that satisfies a time related condition, the

changed in accordance with applied time information.

Preferably, the object to be processed by the information processing apparatus realizes a user interface, and at a timing when object behavior changes with time, the change in the object behavior is presented to the user by changing a component display with animation.

Preferably, the information processing apparatus includes means for performing information processing involving an object of which element or procedure can be described based on time information and an object not dependent on time information.

According to another aspect, the present invention provides an information processing method, including the steps of: determining, on an object of which element or procedure can be described at least on information related to time, contents of the element or procedure of the object based on time information; performing information processing based on the determined contents of processing; and performing adaptive information processing, by storing the object, managing operation and status, and changing contents of the element or procedure described in the object based on the time information.

According to a further aspect, the present invention provides an information processing program, causing a computer to execute the steps of: determining, on an object of which element or procedure can be described at least on information related to time, contents of the element or procedure of the object based on time information; performing information processing based on the determined contents of processing; and performing adaptive information processing, by storing the object, managing operation and status, and changing contents of the element or procedure described in the object based on the time information.

According to a still further aspect, the present invention provides a computer readable recording medium, recording an information processing program causing a computer to execute the steps of: determining, on an object of which element or procedure can be described at least on information related to time, contents of the

element or procedure of the object based on time information; performing information processing based on the determined contents of processing; and performing adaptive information processing, by storing the object, managing operation and status, and changing contents of the element or procedure described in the object based on the time information.

The apparatus and method of information processing, an information processing program and medium of the present invention realize adaptive information processing by changing, with time, property of an object that includes time information in the contents of its element or procedure.

In some embodiments, different time constraints may be set with various time scales and methods of designation mixed, on each of the contents of elements or procedures of the object to be processed, and hence, it becomes possible to realize the apparatus and method of information processing, an information processing program and medium that can describe flexible processing such as changing meaning of a procedure itself dependent on the time of object activation.

In some embodiments, processes under such different time constraints can be contained in a single object, and therefore, object processing based on time information becomes possible even in electric appliances for home use without any communication function.

In addition, in some embodiments, behavior of an object including time constraint information can be referred to or inherited by another object, and therefore, a dependent model in which behavior of a certain object depends on time constraint of another object, or a coordinated model among objects can be built systematically.

In some embodiments, it is possible to realize apparatus, method and medium of information processing that have, as an input source, virtual time information in addition to real time information, effectively improving convenience to contents/service developers in the process of debugging object processing.

In some embodiments, network services can be coordinated under time-

CLAIMS

1. An information processing apparatus, comprising:

determining means for performing, on an object of which element or procedure can be described based at least on information related to time, a process based on time information for determining an element or procedure of said object;

executing means for executing a process based on contents of the process determined by said determining means; and

object management means storing said object for managing its operation and status.

2. The information processing apparatus according to claim 1, further comprising

event notification means registering and holding an event condition based on external information, for notifying said object management means about an event that occurs when the condition is satisfied; wherein

said event notification means and said object management means each include interface means for performing an event input/output operation; and

said executing means changes the process in an event-driven manner in response to said event input/output operation.

3. The information processing apparatus according to claim 1, wherein

said determining means has object generating means for newly generating, after determination of contents of the element or procedure of the object, an object based on the result of determination; and

said executing means performs a process based on said generated object.

4. The information processing apparatus according to claim 1, wherein

information.

8. The information processing apparatus according to claim 1, wherein when said determining means applies time of activation, the object to be processed by said information processing apparatus has a data value or method related to its element or procedure determined.

9. The information processing apparatus according to claim 1, wherein when the determining means applies virtual time of activation, the object to be processed by said information processing apparatus has a data value or method related to its element or procedure, based on the condition, adapted and determined.

10. The information processing apparatus according to claim 9, wherein the object to be processed by said information processing apparatus has contents of its element or procedure described in a form of a time-related function, and when said determining means applies the time information, a data value or method related to its element or procedure is determined.

11. The information processing apparatus according to claim 1, wherein in the object to be processed by said information processing apparatus, different time-constrained condition may be imposed on every uniquely identifiable element or procedure defined in the object, and

said determining means selects an appropriate process at a timing of applying the time information.

12. The information processing apparatus according to claim 1, wherein in the object to be processed by said information processing apparatus, description simultaneously including descriptions based on a plurality of time constraints

element or procedure can be described based on time information and an object not dependent on time information.

30. An information processing method, comprising the steps of:

determining, on an object of which element or procedure can be described at least on information related to time, contents of the element or procedure of the object based on time information;

performing information processing based on the determined contents of processing; and

performing adaptive information processing, by storing said object, managing operation and status, and changing contents of the element or procedure described in the object based on the time information.

31. An information processing program, causing a computer to execute the steps of:

determining, on an object of which element or procedure can be described at least on information related to time, contents of the element or procedure of the object based on time information;

performing information processing based on the determined contents of processing; and

performing adaptive information processing, by storing said object, managing operation and status, and changing contents of the element or procedure described in the object based on the time information.

32. A computer readable recording medium, recording an information processing program causing a computer to execute the steps of:

determining, on an object of which element or procedure can be described at least on information related to time, contents of the element or procedure of the object

based on time information;

performing information processing based on the determined contents of processing; and

performing adaptive information processing, by storing said object, managing operation and status, and changing contents of the element or procedure described in the object based on the time information.